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13. ABSTRACT *(Maximum 200 words)*

The conference is focused on recent advances in understanding the fundamentals of aqueous corrosion of metals, the formation and breakdown of oxide films, the behavior of coating and protective layers, and corrosion in electronic and communications systems. Individual sessions are Oxide films on metals, Oxide films and breakdown, Localized breakdown of passive films and new microscopic technique, Corrosion in electronic and communications systems, Coatings and corrosion protection, Microscopy and localized breakdown of passive films, Chemical and mechanical effects on oxide film adhesion and fracture. The speakers have been selected on the basis of their unique contributions to, and their knowlege of, the subject area. Several are new speakers and five are from outside the USA. The Seesion discussion leaders also have a wide background on corrosion and have been selected for their leadership and contributions to corrosion, and their experience with the Gordon Conference format.

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1996 Gordon Conference on Aqueous Corrosion

FINAL PROGRESS REPORT

AFOSR Grant No. F 49620-96-1-0148

The Conference was held on July 7-11, 1996 at Colby Sawyer College in New London, New Hampshire. The focus was on recent advances in understanding the fundamentals of formation and breakdown of oxide films on metals, and on other protective films and layers, of special interest to aqueous corrosion. Two special interest days were devoted to Corrosion in Electronic and Communication Systems, and Coatings and Corrosion Protection. Individual sessions were

Oxide Film on Metals and Their Breakdown,
Localized Breakdown of Passive Films, and
Microscopic Techniques for Study
Corrosion in Electronic and Communication Systems
Coatings and Corrosion Protection
Mechanical and Chemical Effects on Oxide Film Adhesion and Fracture

Speakers that were knowledgeable in each area were selected. The complete program is attached. Special attention was given to selection of young speakers and discussion leaders, and one third of the speakers fit this criterion. Speakers from Japan, United Kingdom, Italy, and Germany were on the program as well.

A highlight of the Conference was the poster session by 35 graduate students and postdoctoral associates. They each gave a short oral summary of the posters at the technical sessions, and this was very successful. The participation by these younger people in other parts of the Conferences was quite high as well.

The new format, i.e., Sunday evening through Thursday evening, was popular. The attendance at the last session on Thursday evening was 85, a good fraction of the total attendance of 95.

Oxide Films on Metals

Two new techniques for investigation of oxide films were highlighted. The first was in situ grazing incidence angle x-ray scattering which can reveal the structure and orientation of thin oxide films on metal surfaces. It was found that the oxide film grown on single crystal iron was neither γ-Fe_2O_3 nor Fe_3O_4, historically popular choices, but apparently a spinel-like Fe_2O_3. A second technique, XANES, also requiring a synchrotron light source, was used to study sputter deposited films of iron and chromium oxides. It was of interest to explore changes in structure and oxidation state upon exposure to aqueous solutions at different potentials and pH. Although easier to use, the results are more qualitative and less definitive than the x-ray scattering technique.

Oxide Films and Breakdown

The use of in situ stress measurements on oxide films was described for iron substrates. Models for breakdown and pitting were explored for iron alloys, and contended that inclusions were required to nucleate pits, and the inclusions must be of a minimum size to propagate the pits. Microscopic techniques to explore the regions around inclusions were described in another contribution. The techniques included the classical ex-situ SEM/EDAX standard as well as scanned pH probe microscopy and confocal laser scanning microscopy with fluorescent probes.

The ability to probe single grains of a polycrystalline surface was demonstrated for titanium. 50 micrometer areas on individual grains (~200 micrometer in diameter) were defined and studied with microellipsometry, electrochemical impedance and polarization, and photoelectrochemical techniques. The techniques when used together were able to reveal the variation in oxide film properties that were generated from grain to grain on the metal surface.

Confocal laser scanning microscopy with fluorescent probes was described in a second contribution at the Conference. pH sensitive dyes in solution revealed local pH

GORDON RESEARCH CONFERENCE

1996

AQUEOUS CORROSION

W.H. Smyrl, Chairman

D.J. Young, Vice-Chairman

Technical Sessions

Sponsored by:
Gordon Research Conference Special Fund
National Science Foundation
Office of Naval Research
Air Force Office of Scientific Research
University of Minnesota Corrosion Research Center

INTRODUCTION

The Gordon Research Conferences were established to foster the open sharing of new scientific findings and theories between researchers in the field. Unlike most other conferences, a full week is dedicated to presentations in one area. The talks and discussions are typically of such a duration to allow in-depth exposition and full discussion of a specific session topic. Speakers are selected by the chairman for their expertise and recent progress in areas deemed to be at the frontiers of science.

Another key aspect of the conference is accessibility. The opportunity for informal discussions outside the lecture program is unique in that attendees stay in college dormitories, have meals together and otherwise socialize in the free afternoon periods or after the evening sessions. There is also the opportunity for attendees to present their own work through poster sessions. This format is particularly helpful for graduate students and new researchers in the field to make personal contacts with established experts and international attendees.

THE 1996 CONFERENCE ON AQUEOUS CORROSION

The conference is focused on recent advances in understanding the fundamentals of aqueous corrosion of metals, the formation and breakdown of oxide films, the behavior of coating and protective layers, and corrosion in electronic and communications systems. Individual sessions are

Oxide films on metals
Oxide films and breakdown
Localized breakdown of passive films and new microscopic technique
Corrosion in electronic and communications systems
Coatings and corrosion protection
Microscopy and localized breakdown of passive films
Chemical and mechanical effects on oxide film adhesion and fracture

The speakers have been selected on the basis of their unique contributions to, and their knowlege of, the subject area. Several are new speakers and five are from outside the U.S.A.

The session discussion leaders also have a wide background on corrosion and have been selected for their leadership and contributions to corrosion, and their experience with the Gordon Conference format.

ATTENDEES

The technical sessions have been structured to allow in-depth discussion of the issues raised, with extensive participation by the attendees. We especially note the attendance and participation of graduate students and postdoctoral associates. The poster session should be an invaluable part of the Conference.

SPONSORS

The chairman is grateful for finanacial support from the Gordon Research Conference Special Fund, NSF, ONR, AFOSR, and the U of MN CRC.

SCHEDULE OF EVENTS

Sunday, July 7

7:30 p.m.	Technical Session

Monday, July 8

9:00 a.m.	Technical Session
9:30 a.m.	Spouse and Guest Reception
3:00 - 4:30 p.m.	Poster Session Begins
4:30 - 6:00 p.m.	Chairman's Reception, Conference Center
7:30 p.m.	Technical Session

Tuesday, July 9

9:00 a.m.	Technical Session
7:30 p.m.	Technical Session

Wednesday, July 10

9:00 a.m.	Technical Session
7:30 p.m.	Technical Session

Thursday, July 11

9:00 a.m.	Technical Session
7:30 p.m.	Technical Session
10:30 p.m.	Close of Conference

GORDON RESEARCH CONFERENCE

Aqueous Corrosion

July 7-11, 1996

William H. Smyrl, Chairman
University of Minnesota

D.J. Young, Vice Chairman
University of New South Wales

Sunday, July 7 Evening Session *Oxide Films on Metals*

Discussion Leader: Dr. Alison Davenport

Speakers:

* Dr. M.J. Toney, IBM Almaden Research Center
"X-ray Diffraction Measurements on Anodic Oxide Films"

* Dr. Patrik Schmuki, Brookhaven National Laboratory
"in-situ XANES of Artificial Fe and Cr Oxide Passive Films"

Monday, July 8 Morning Session: *Oxide Films and Breakdown*

Discussion Leader: Dr. Rob Kelly

Speakers:

* Professor Masahiro Seo, Hokkaido University
"Corrosion of Fe, Formation and Interfacial Properties of Oxide Films on Fe"

* Professor G.T. Burstein, University of Cambridge
"Oxide Films and Their Breakdown"

Evening Session: *Localized Breakdown of Passive Films and New Microscopy Techniques*

Discussion Leader: Dr. Hugh Isaacs

Speakers:

* Dr. Edward McCafferty, Naval Research Laboratory
"Pitting and Its Inhibition"

* Professor Richard Alkire, University of Illinois
"Various Microscopic Techniques to Study Onset of Local Corrosion Events"

Tuesday, July 9 *Corrosion in Electronic and Communication Systems*

Discussion Leader and Organizer: Dr. Doug Sinclair, AT&T Bell Laboratories

Morning Session:

Speakers:

* Dr. Robert Frankenthal, AT&T Bell Laboratories
  "Effect of AC and DC Power on the Corrosion of the Metal Shield in Coaxial Cables"

* Dr. Vlasta Brusic, Cabot Corporation
  "Use of Organic Inhibiting Films in the Electronic Industry"

Evening Session:

Speakers:

* Dr. Gerald Frankel, Ohio State University
  "Corrosion of Electronics - Future Problems and Challenges"

* Dr. Jim Anderson, Ford Research Laboratory
  "A Systematic Experimental Approach to Processing and Performance Windows to Insure Reliability of Electronic Devices Operating under Harsh Environmental Conditions"

Panel Discussion: Frankenthal, Brusic, Frankel, Anderson

Wednesday, July 10 *Coatings and Corrosion Protection*

Discussion Leader and Organizer: Dr. Gordon Bierwagen, North Dakota State University

Morning Session:

Speakers:

* Professor Pier Luigi Bonora, University of Trento
  "Corrosion Control by Coatings: Achievements and Trends"

* Dr. Carol Jeffcoat, North Dakota State University
  "Effects of Thermal Transitions in Organic Coatings on Their Electrochemical and Corrosion Protection Properties"

Evening Session:

* Dr. Steven Tait, S.C. Johnson and Son
  "Where Are We With Predicting Coated Metal Lifetimes?"

* Dr. Rudy Buchheit, Sandia National Laboratory
  "Scientific Strategies Versus Technological Barriers in the Development of Environmentally Acceptable Alternatives to Corrosion Resistant Conversion Coatings for Aluminum Alloys"

Thursday, July 11 Morning Session: *Microscopy and Localized Breakdown of Passive Films*

Discussion Leader: Professor Florian Mansfeld

Speakers:

* Professor J.W. Schultze, University of Dusseldorf
"Microelectrochemical, Spectroscopic and AFM Investigations of Single Grains of Polycrystalline Metal Surfaces"

* Dr. Patrick James, University of Minnesota
"Microvisualization of Corrosion Events"

Evening Session: *Chemical and Mechanical Effects on Oxide Film Adhesion and Fracture*

Discussion Leader: Dr. Paul Natishan

Speakers:

* Professor W.W. Gerberich, University of Minnesota
"Nanomechanical Probing of Chemo-Mechanical Interactions at Surfaces"

* Professor David J. Duquette, Rensselaer Polytechnic Institute
"Electrochemistry in Chemical-Mechanical Polishing of Electronic Materials"

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